REMARKS

In the Office Action, dated April 13, 2005, the Examiner states that Claims 1 and 2 are pending and Claims 1 and 2 are rejected. By the present Amendment, Applicant amends the claims.

In the Office Action, Claims 1 and 2 are rejected under 35 U.S.C. §103(a) as being unpatentable over Sada (U.S. 5,997,988) in view of Nishioka et al. (U.S. 6,367,439). The Applicant has amended Claim 1 to incorporate the features of Claim 2, and respectfully traverses the rejection.

The present invention relates to a rotation-contact type valve train, wherein the members in contact with each other rotate synchronously such as a rotating cam lobe 2 and a rotating roller 4 as shown in FIG. 1. It is a feature of the present invention that, in a combination of members such as the cam lobe and the roller, which synchronously rotate in a contacted state, each surface roughness Ra of the outer circumferential surface of the cam lobe made of an iron based sintered material and the outer circumferential surface of the roller is set in a specific range, that is, Ra of 0.4 to 2.2 μm. Thereby, the dynamic friction coefficient between the cam lobe and the roller follower is increased, and minute slippage is eliminated with the result that the friction loss in the valve train system is reduced, and at the same time, the pitching resistance is sufficiently improved.

The rejection indicates that it cannot be read from the specification that the present invention exhibits the effect of reducing friction loss. However, the effect of reducing friction loss is shown in Table 1 to Table 3 and FIG. 4 to FIG. 6 of the present specification. Further, there is an explanation at the bottom of p. 15 to the bottom of p. 17 of the present specification. Moreover, it is shown in Table 7 and FIG. 7 of the present application that the present invention exhibits the effect of improving the pitching resistance. Further, there is an explanation at p. 19, lines 1 to 10 of the present specification.

In Sada, it is described that Ry (maximum height) of the circumferential direction of a roller follower is 1.1 μm or 1.4 μm. The rejection indicates that in Sada it is mentioned that the surface roughness of the outer circumferential surface of the roller is applicable to other parts in rotation-contact and slide-contact (column 5, lines 36 to 39). However, Sada only describes that Ry of one member of the combined members is set to be 1.1 μm or 1.4 μm. Sada does not at all describe to set both Ry

of the roller and Ry of the cam lobe to be 1.1 μm or 1.4 μm. The combination described in column 6, lines 58 to 67 in Sada is only a combination of Ry (maximum height) of the circumferential direction of the roller being 1.1 μm or 1.4 μm and Ry of the circumferential direction of the drive wheel 60 equivalent to the cam being 3 μm. For Sada, it is not always a preferred combination that both Ry of the roller and Ry of the cam lobe are set as 1.1 μm or 1.4 μm since it is not mentioned in Sada that Ry of both members combined are preferably 1.1 μm or 1.4 μm.

As for the object of the invention, the object of Sada is to obtain a stable capability to form an oil film by controlling the very small recesses, whereas the object of the present invention is to increase the dynamic friction coefficient between the cam lobe and the roller, eliminating the minute slippage of rotation-contact and reducing the friction loss. Therefore, the object of the present invention is quite different from that of Sada.

Further, as for an object of the present invention, the present invention aims to solve problems specific to a rotation-contact type valve train. On the contrary, Sada does not aim to solve the problems specific to a rotation-contact type of valve train since there is indicated in Sada that the surface roughness of the outer circumferential surface of the roller may be applied to other rotation-contact or slide-contacting parts (col. 5, lines 36-39 of Sada).

Therefore, it cannot be considered that it is easily conceived from Sada to set Ry of both the roller and cam lobe, which are members that rotate synchronously in a contacted state, as 1.1 μm or 1.4 μm, aiming at controlling the surface roughness and reducing the friction loss of a rotation-contacting type.

Moreover, even from the translation of the JIS B0601 submitted previously, relevance between Ry (maximum height) of 1.1 μm or 1.4 μm and Ra (mean roughness) of 0.4 to 2.2 μm specified in the present invention cannot be found. Hence, it cannot be considered that it is easily conceived from Sada to set Ra of the outer circumferential surface of a cam lobe, which is a rotation-contacting type and made of an iron based sintered material, and the outer circumferential surface of a roller, to the range of 0.4 to 2.2 μm. The Examiner asserts that there is no mention of "Ra", meaning the mean roughness, in the specification of the present invention. However, this is common knowledge for one skilled in the art that "Ra" means the

Arithmetical mean roughness. To support this fact, an English translation of JIS B0601 has already been submitted.

On the other hand, in Nishioka et al., a cam lobe made of an iron based sintered material is mentioned. However, Nishioka et al. only discloses a slipper follower type cam lobe made of an iron based sintered material.

A feature of Nishioka et al. is, in a combination of a shim and a cam which slide by a reciprocating mechanism, that the surface roughness in 10-point mean surface roughness Rz of the shim is specified in the range of 0.07 to 0.2 μm, and further an area ratio of an open pore of the cam is specified to 2 to 6% (col. 8, lines 28-50).

Nishioka et al. discloses means to control boundary lubrication, which is likely to occur under high surface pressure, and to maintain fluid lubrication for improvement of sliding characteristics of a slipper follower type valve train mechanism.

The reciprocating mechanism (slipper follower type) of Nishioka et al. and the rotation-contacting type of the present invention are different in operating condition and the object thereof. The present invention aims to solve the problem that friction loss is caused due to inefficient rotation if a minute slippage occurs between a cam lobe and a roller, which are members that rotate synchronously in a contacted state. To the contrary, Nishioka et al. does not disclose this problem at all because the combination of the shim and the cam of Nishioka et al. is a slipper follower.

Therefore, even if the invention of Sada and the description in Nishioka et al. are taken into account, one skilled in the art cannot easily conceive the present invention, wherein the surface roughness Ra of both the outer circumferential surface of a cam lobe, which is a rotation-contacting type and made of an iron based sintered material, and the outer circumferential surface of a roller, are specified to 0.4 to 2.2 μm so as to increase the coefficient of dynamic friction between the cam lobe and the roller, to eliminate the minute slippage upon rotation–contact, and reduce the friction loss in the valve train system.

In light of the foregoing response, all the outstanding objections and rejections are considered overcome. Applicant respectfully submits that this application should now be in condition for allowance and respectfully requests favorable consideration.

Respectfully submitted,

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